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Advanced Mobile Traffic Information and Communication System - AMTICS

p 475-483

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ABSTRACT

In January, 1987, Japan Traffic Management Technology Association, by the suggestion of National Police Agency, set up a group to study proposals for the Advanced Mobile Traffic Information & Communication System (AMTICS) in cooperation with Ministry of Posts and Telecommunications (MPT) and private corporations.

AMTICS is an integrated traffic information and navigation system. The system will display on screen in each vehicle traffic information gathered at Traffic Control and Surveillance Centers managed by the police in 74 cities. The information is reprocessed by computer at the AMTICS data processing center and broadcast to vehicles. The broadcasting system being promoted by MPT is a new radio data communication system called teleterminal. The equipment in vehicles will consist of a display, a compact disk-read only memory (CD-ROM) reader for retrieving information stored on CDs, and a microcomputer to calculate the vehicle's position and to superimpose it on the display.

The major benefit of this system will be its ability to display in real time, not only the vehicle's current position and route, but also information on traffic congestion, regulation, road work and parking. The system is also being considered for application to business vehicle management systems.

On 27th, April 1987, after the AMTICS research group issued its report, a Conference on the Practicability of AMTICS was established with the participation of 59 private corporations. A pilot experiment was carried out in Tokyo in April, 1988 for three months. By this pilot test, we were confident the technology of hardware and software for AMTICS. And on 16th June, 1989, a Conference on Experiment of AMTICS in Kansai district was established with the participation of about 45 private corporations. The first commercial system will be available in Tokyo in 1990.

1. BACKGROUND AND HISTORY OF DEVELOPMENT

Furnishing traffic information to moving automobiles and other vehicles has become an increasingly important subject along with traffic congestion and expansion progress of areas.

According to the "Survey on the Actual Condition of Road Traffic Information Demand" conducted by the Japan Road Traffic Information Center in 1985, the leading situation in which the need for information develops is "when having been trapped in a traffic jam" (65% of responses). The types of information needed then are: "the length of the traffic jam" (58.7%), "the cause of the traffic jam" (36.1%), "the probability that the traffic congestion will clear" (53.7%), and "a detour route" (35.6%). On the other hand, many drivers complain that they "cannot obtain information they want" (88.1%). The furnishing of traffic information by radio, which is the frequently used method, has elicited strong requests from drivers for an expansion of provided information, such as: "want broadcasts for times other than the current times" (49.7%), "want an increase in the number of broadcasts" (55.8%), and "want an extension of the broadcast time per broadcast" (39.1%).

Japan Traffic Management Technology Association (hereinafter referred to as "T.M.T.") has long been conducting research on sophisticated traffic information service under the supervision of National Police Agency. In 1987, T.M.T. started to study new ideas for developing a system to respond to such need of drivers in both quantitative and qualitative aspects.

Based on the vehicle navigation system, for which technical development has been recently conducted in each field (It shall be more appropriate to call the currently realized "the vehicle location system". Therefore, it is referred to as the location system, hereinafter.), one idea is to add to the location system into the traffic jam information that drivers desire the most, and to show this information on a display inside the vehicle.

This system has been named the Advanced Mobile Traffic Information and Communication System (AMTICS). A fundamental idea is to supply various type of traffic information, centered round traffic congestion, accident etc., from the police traffic control centers (currently established in 74 cities nationwide), and to use the proposed teleterminal system of Ministry of Posts and Telecommunications as the communication media to send the information to each automobile.

With this background, the AMTICS research group (Chairman: Fumio Minozuma) was established at the beginning in 1987 to study the possibility of making practicable this system. This study was conducted from the perspective of the technical aspects as well as the business ones. The results were reported at the final study session, held on 27th April, 1987. The conclusion was that there was sufficient possibility of its practical use.

Based on the results of the AMTICS research group, on 27th April, an organization meeting was held with 45 companies, and the Conference on the Practicability of AMTICS (Chairman: Fumio Minozuma) was officially inaugurated.

Further, this conference consigned study on the practical use of this system to T.M.T. again in June, 1987, and T.M.T., responding to this, inaugurated the AMTICS Development Committee (Chairman: Hiroyuki Okamoto). It is presently proceeding with the work toward practical utilization of this system in cooperation with National Police Agency, Ministry of Posts and Telecommunications, Tokyo Metropolitan Police Department, and 59 private companies as of 31st October, 1987.

2. OUTLINE OF THE SYSTEM

(1) Configuration of the System

This system provides the vehicle location system (to display a road map and the vehicle location on the screen mounted in the vehicle) that is currently being developed in each field with traffic information collected at the traffic control centers online/real-time through the teleterminal system. Figure 1 is a system schematic diagram.

The main functions of this system are follows:

- 1 Vehicle location:
Displaying road map and vehicle location
- 2 Traffic information:
Supplying of information on traffic jam, traffic regulation, weather, etc.
- 3 Related information:
Supplying of information such as location and availability of parking lots, and location and entertainment of tourist resorts
- 4 Application for business communication:
Application for locating vehicle owned by the company and for business communication

This system also provides the traffic information to the guide terminals which are installed at gas stations, railroad stations, hotels and so forth.

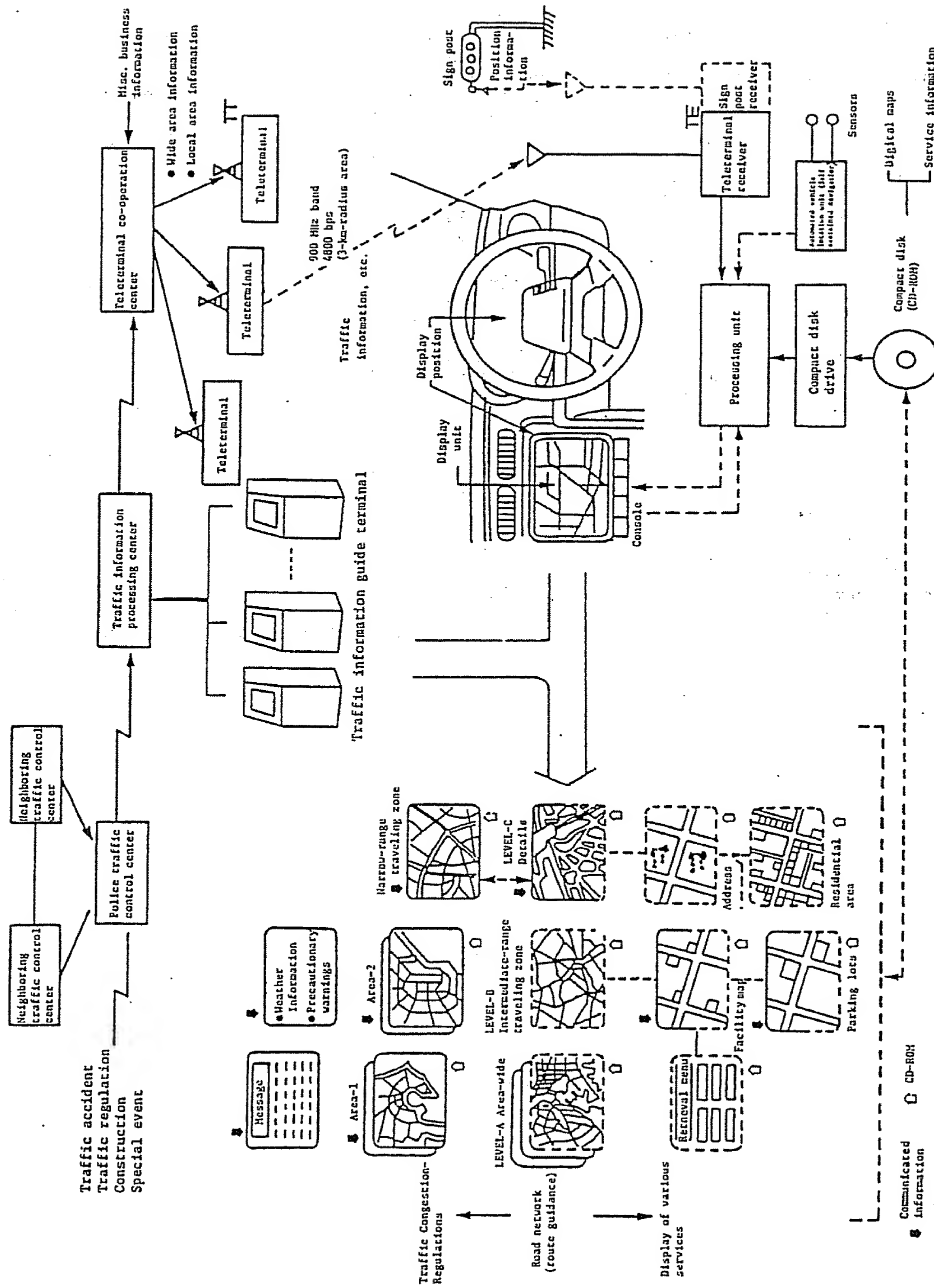


Figure 1 System Schematic Diagram

(2) Information Supplied by AMTICS

The two types of information supplied by this system are:

- 1 Dynamic information supplied through teleterminal system
- 2 Static information recorded on a compact disk recording medium (hereinafter referred to as "CD-ROM")

Table 1 lists each type of information

Table 1 Types of Information Supplied by AMTICS

Dynamic information	<p>Traffic congestion information</p> <p>Temporary traffic regulation information (construction, accident, events, freezing condition in mountain area, etc.)</p> <p>Urgent information, such as precautionary warning</p> <p>Weather information</p> <p>Parking space availability information, etc.)</p> <p>Others (route guidance information, etc.)</p>	Basic information	Supplied through teleterminal system
Static information	<p>Road network data</p> <p>General traffic regulation (one-way, no right turn, etc.)</p> <p>Location of parking lot</p> <p>Background data (railroad, river, coast, administrative boundary, etc.)</p> <p>Location of major facility (school, hospital, etc.)</p> <p>Location of gas station and service facility</p> <p>Tourist information</p> <p>Residential map</p> <p>Others</p>	Service information	Supplied by recording medium

The coverage of information service shown on the display depends on the type of information. For example, for traffic jam information there are two types, local area information and wide area information, and the driver can select either type and view it. The former regards as one unit a circle of a radius of 8km with a teleterminal at its center.

The latter is an area which size is as wide as the prefecture. (In some cases, parts of the neighboring prefecture are included.) Naturally, the former is partial and dense information, and the latter is general information about main sections. Figure 2 shows the relationship between the service area of a teleterminal (described later) and the coverage of this information service.

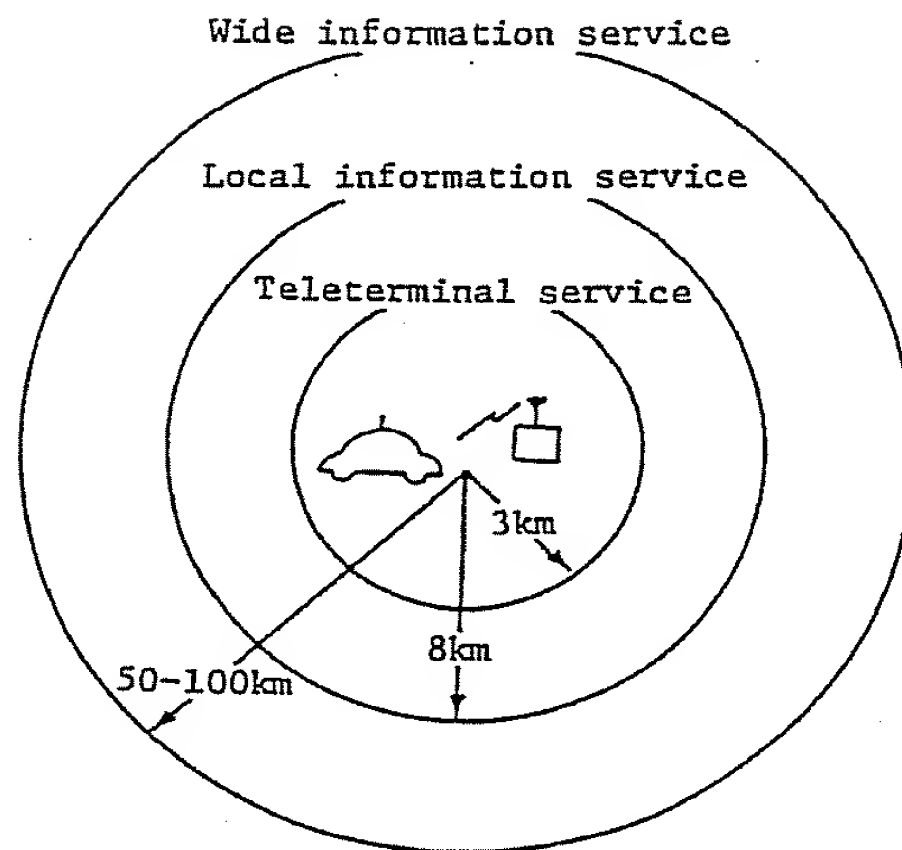


Figure 2 Coverage of Information Service

3. FUNCTION OF EACH PART OF THE SYSTEM

The outline of the function for the main parts shown in Figure 1, System Schematic Diagram, is follows:

(1) Traffic Control Center of Police

The traffic control center calculates the lengths of traffic jam line, the degree of congestion from information on the traffic volume, speed, etc., collected from the vehicle detector set up on roads. It controls the traffic signal on line so that the traffic flows in the most appropriate manner. In addition, it displays the collected traffic congestion information on the wall map display panel established in the center. (The traffic jam condition is displayed in three colors depending on the degree of congestion on a simplified map panel of a road network.) It performs general traffic management by the operator, broadcasts radio traffic information to the general public, and provides the driver with information through variable message signs and roadside

re-broadcasting equipment.

Figure 3 shows a concept of the traffic control system. This system is currently installed in 74 major cities nationwide. For example, traffic signals are installed at approximately 12,000 intersections in Tokyo, approximately 6,000 of which are controlled by the traffic control center.

Further, the information about accident, construction and temporary traffic regulation etc., is manually entered into the computer at the traffic control center. At the same time, it is displayed on the wall map display panel.

As one example, Figure 4 and Table 2 show a configuration chart indicating the condition of the equipment and the size of the system of the traffic control center at Tokyo Metropolitan Police Department.

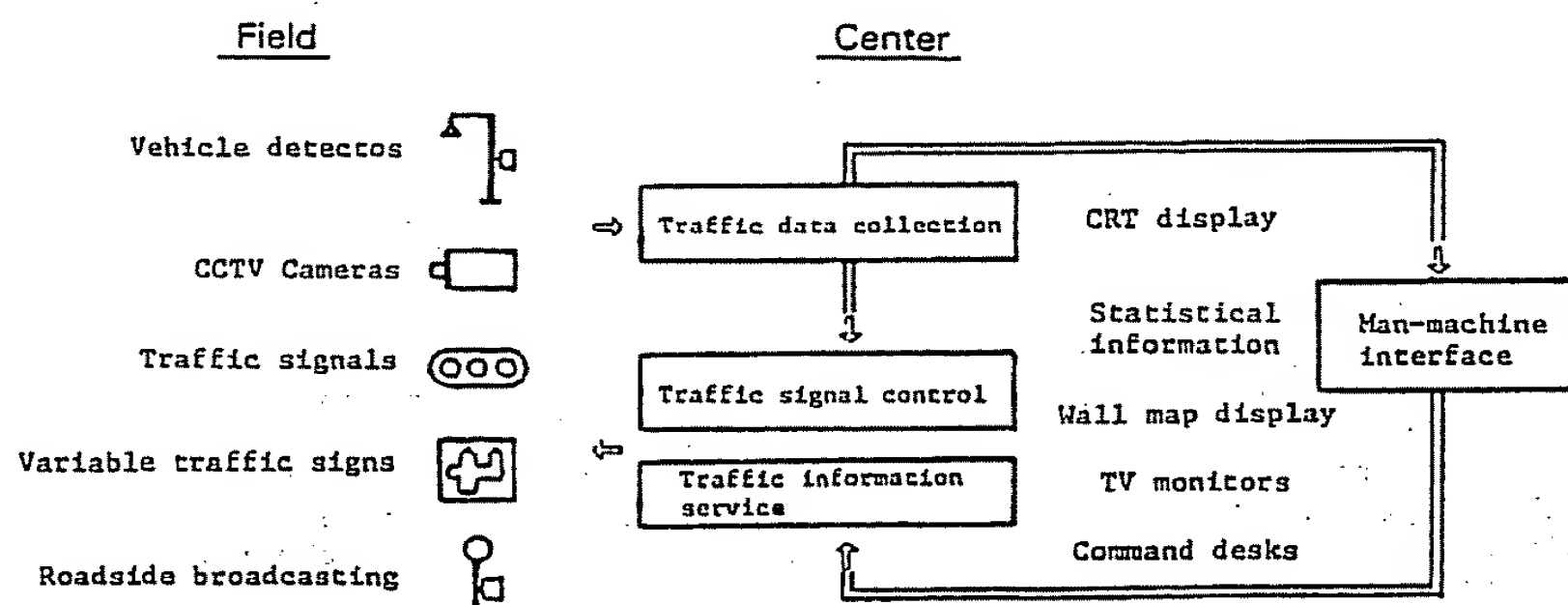


Figure 3 Concept of Traffic Control System

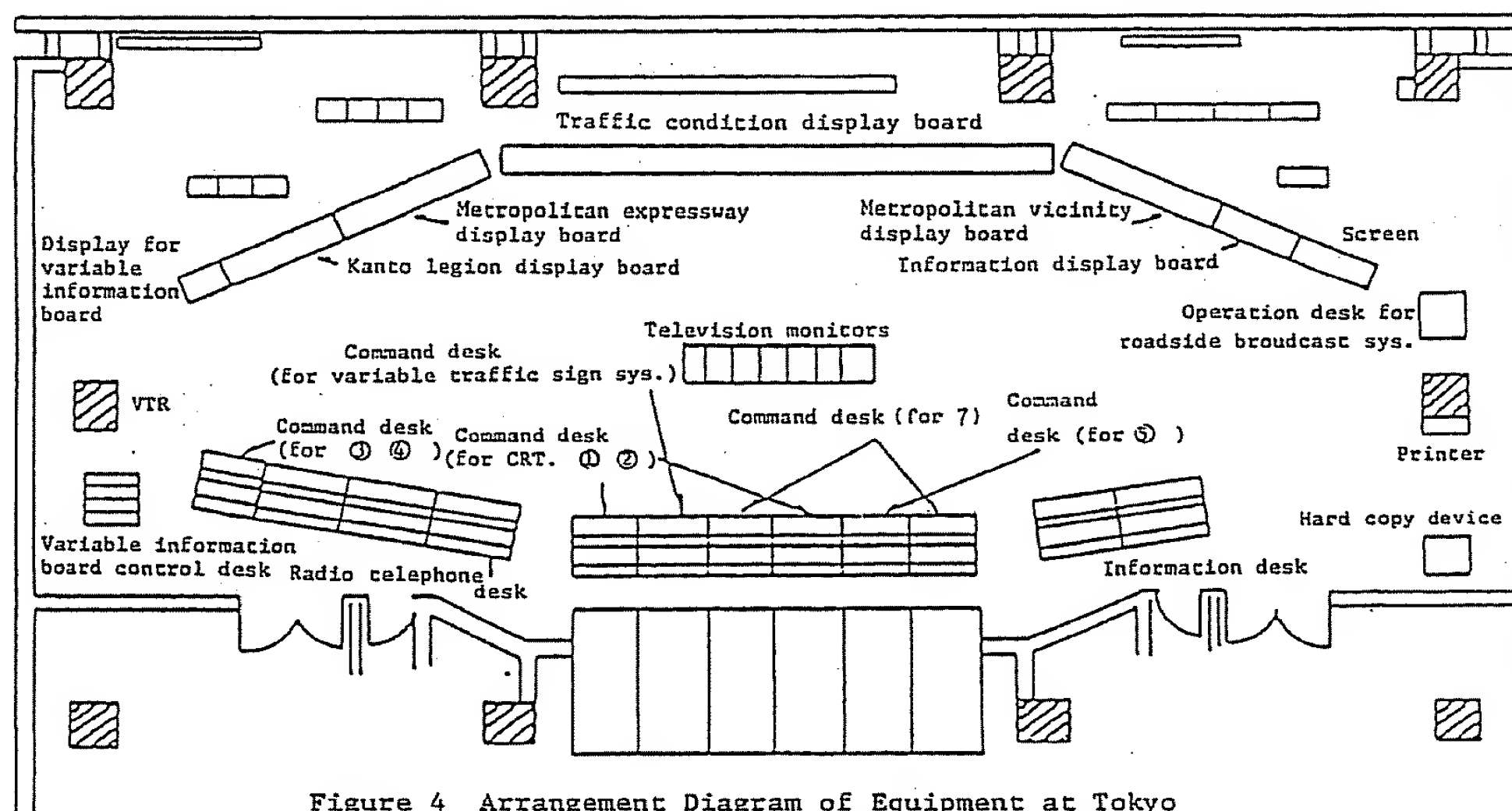


Figure 4 Arrangement Diagram of Equipment at Tokyo Traffic Control and Surveillance Center

Table 2 Size of Traffic Control System at Tokyo Metropolitan Police Department (As of July, 1987)

Component	Size
Controlled traffic signal	6,023 intersections (Total number of traffic signals: 12,315)
Vehicle detector	5,691 units
Intersection displayed on wall map	462 intersections
CCTV camera	81 units
TV monitor	20 units
Large computer	1 system:
Medium computer	22 systems:
Small computer	22 systems:
Area of machine room, etc.	1,380 m ²
First machine room	430 m ²
Second machine room	330 m ²
Traffic control center	320 m ² (excluding broadcasting room, office)
Broadcasting room	8 rooms (6 rooms used)

(2) Traffic Information Processing Center of AMTICS

To display information, such as traffic condition received from the traffic control center and parking space availability sent from another source to be overlapped on a road map, the processing center rearranges the contents and adds required information. Furthermore, it converts the information so that it matches the transmission format of the teleterminal system, and then sends it out to the teleterminal cooperation center.

This center defines as one of the users of the teleterminal system.

(3) Teleterminal System

This system is managed by Ministry of Posts and Telecommunications and is developed with the Research and Development for Radio Systems. It is a communication system to perform data between vehicle and user or between two vehicles. The system configuration is as follows. Teleterminal (tele-communication terminal) that has a service area of approximately 3 km radius is established in many places in the city, and each of them is connected with the co-operation center by a communication line. As a whole, it constitutes a system to cover the entire city. The co-operation center is further

connected with each user by a communication line, and the vehicle is connected with each teleterminal by radio. The teleterminal system plays a role of transmitting traffic information sent from the processing center to the driver.

Now, three teleterminals are installed in the central part of Tokyo for pilot purpose, and about 10 teleterminals are scheduled to be installed for practical use by 1990 to cover entire Tokyo metropolitan area.

(4) On-vehicle Equipment

Figure 5 shows an example of the configuration of the units related to the on-vehicle display.

The on-vehicle equipment detects the position of the vehicle itself by the distance (distance traveled) sensor and the directional sensor, and it displays

the position of the vehicle on the road map shown by the output from CD-ROM.

This vehicle location system is characterized by a map matching method, in which the vehicle's position when changing direction and traveling distance is always compensated according to the road map stored in the CD-ROM.

At this map matching method, a set of correlation function between the trajectory and the road map is always calculated statistically determining the vehicle's exact location on the road.

Figure 6 shows the feature of the map matching method, and the trajectory is displayed as being off road in some case until the turning point is recognized, and it is quickly recovered on the correct street on the display.

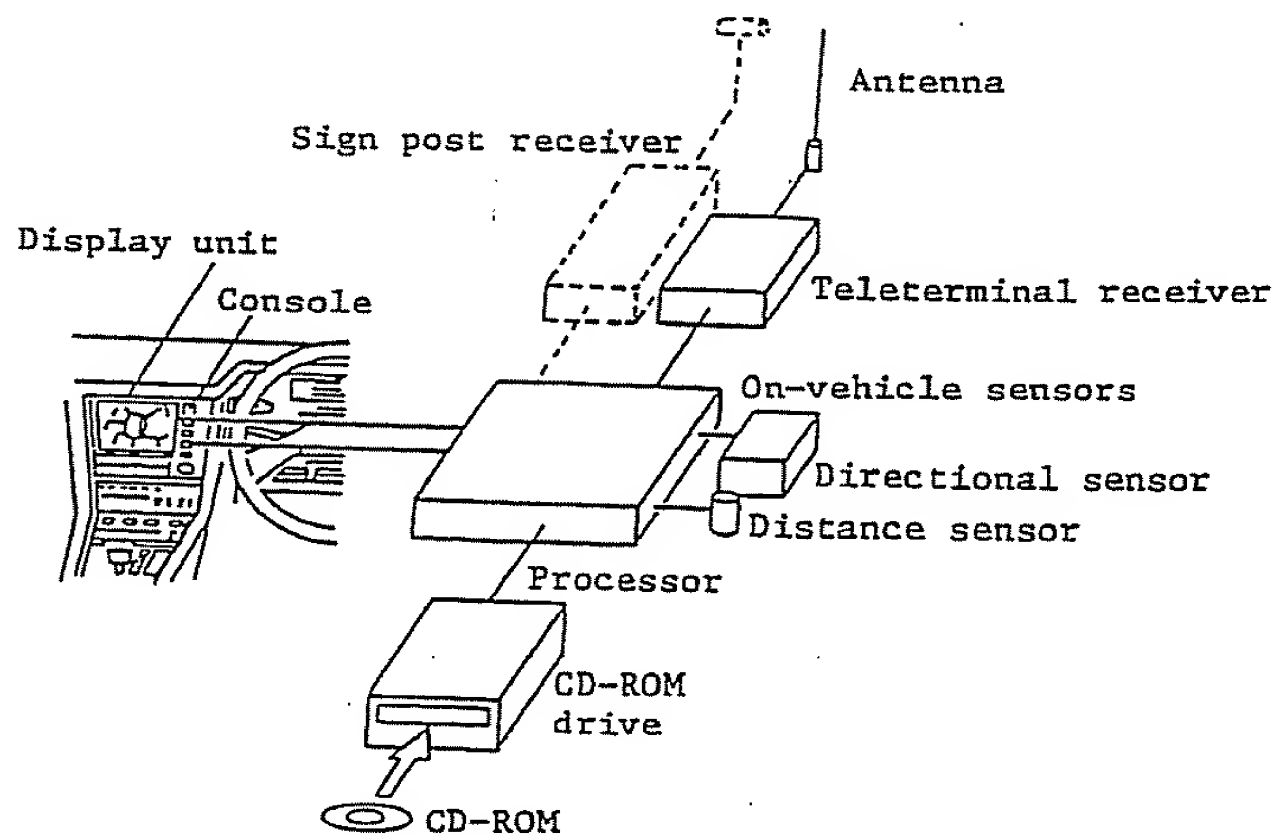


Figure 5. Sample Configuration of On-vehicle Unit

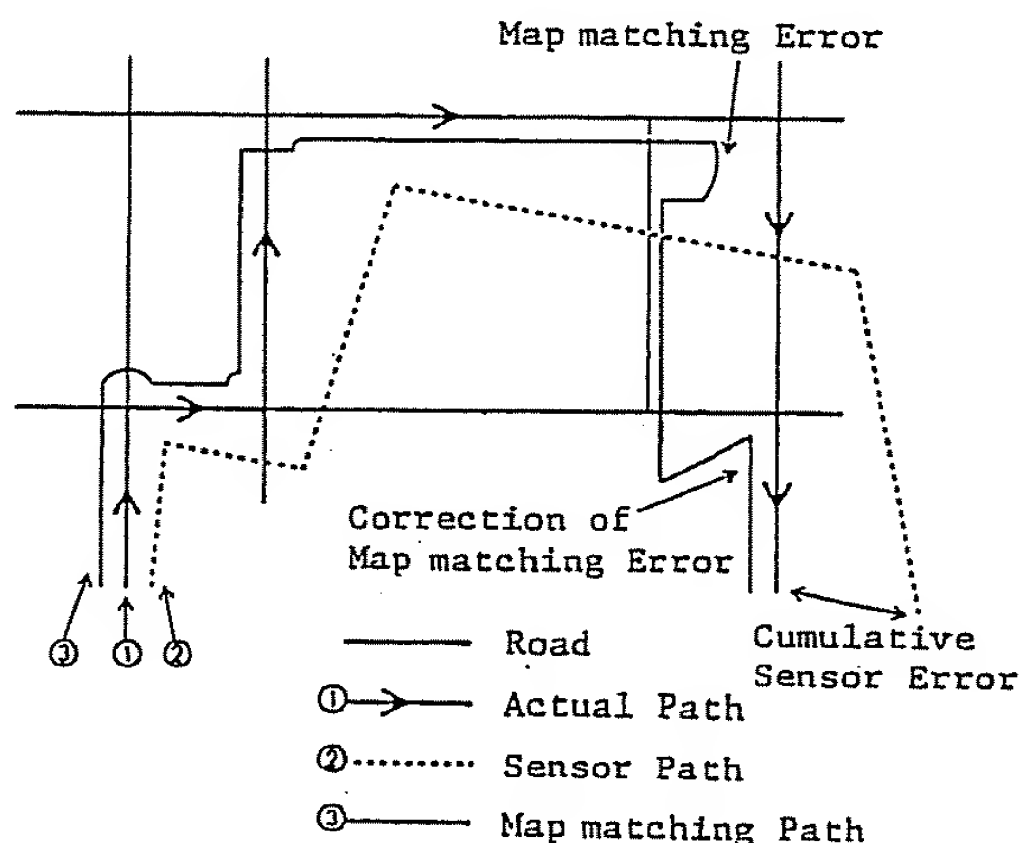


Figure 6. Feature of Map Matching Method

It also displays various information overlapped on the same screen through the teleterminal. In addition, various service information on CD-ROM is also displayed.

We consider in this system to use voice as a mean of communication to the driver rather than display on the screen.

Manufacture of on-vehicle unit is to make trial models. The fundamental idea directs to limit the standard specifications to be minimized so that the creativity of the manufacturing company in charge can be sufficiently expressed. For reference, Figure 7 shows an example of the on-vehicle display.

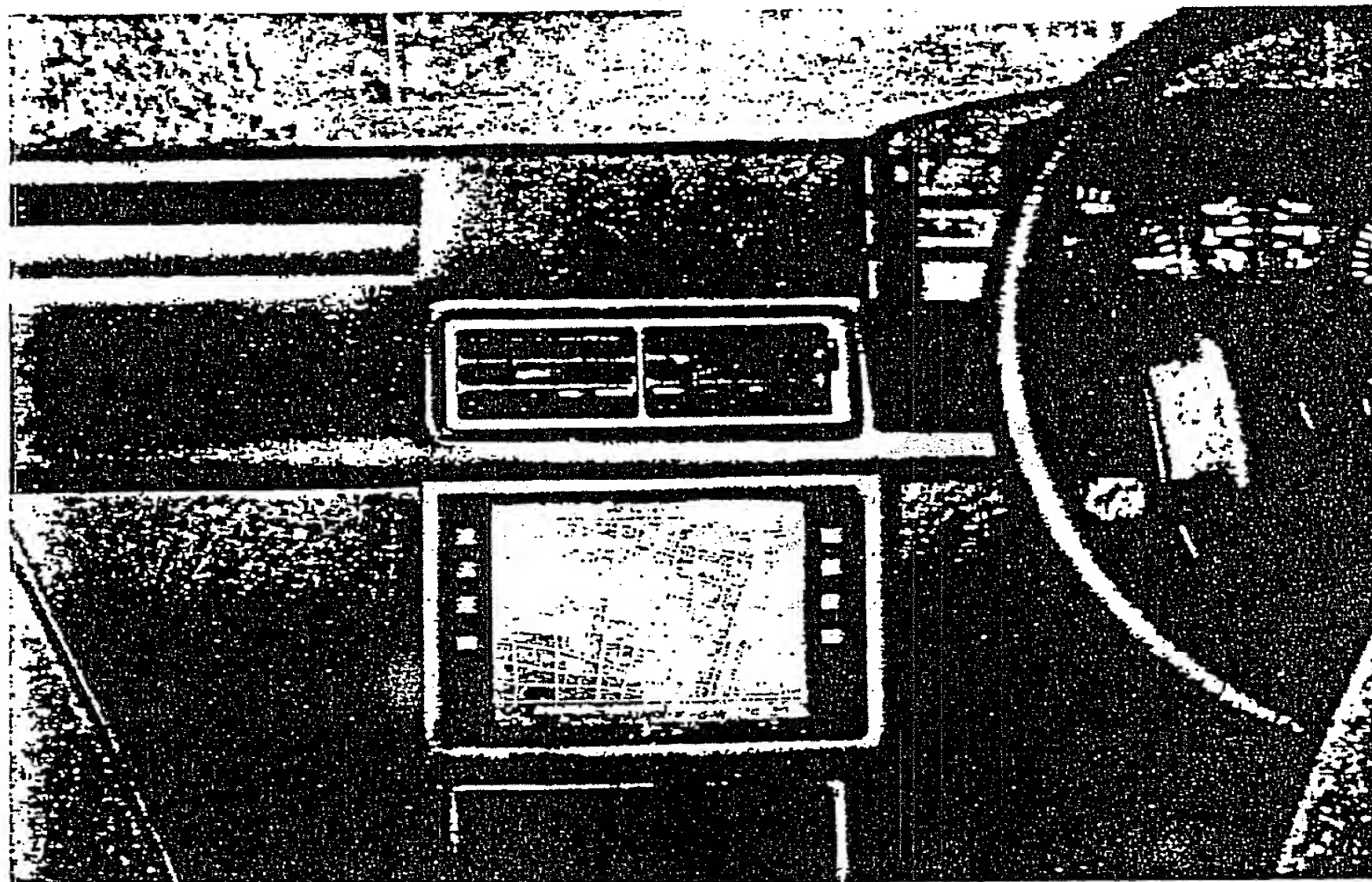


Figure 7. Example of On-vehicle Unit

(5) Map Storage (CD-ROM)

Many kinds of media can be used to memorize road maps, and CD-ROM is the most practical at present due to capacity, accessibility, cost, etc. The main specification of CD-ROM is as follows:

- 1 Capacity: 540 MB
- 2 Transfer speed: 150 KB/sec
- 3 Access method: Random access
- 4 Other: Read only

Various static informations are stored in this CD-ROM. As an example, if only map is stored in one CD-ROM, all the roads in the Kanto Area (roads with a width of 2.5 m or wider including background data) can be stored.

(6) Sign Post

The sign post is used to correct detection of the vehicle position caused by error of the distance and directional sensors. However, it is unnecessary if the detection accuracy of the vehicle position will be improved in future.

(7) Traffic Information Guide Terminal

Traffic information guide terminal is connected directly with the processing center through telephone line, and receives traffic information of entire Tokyo metropolitan area and surroundings.

Traffic information on road map is displayed on the CRT and designate the location touching on the screen by finger.

It is installed at service station, hotel lobby, supermarket, etc.

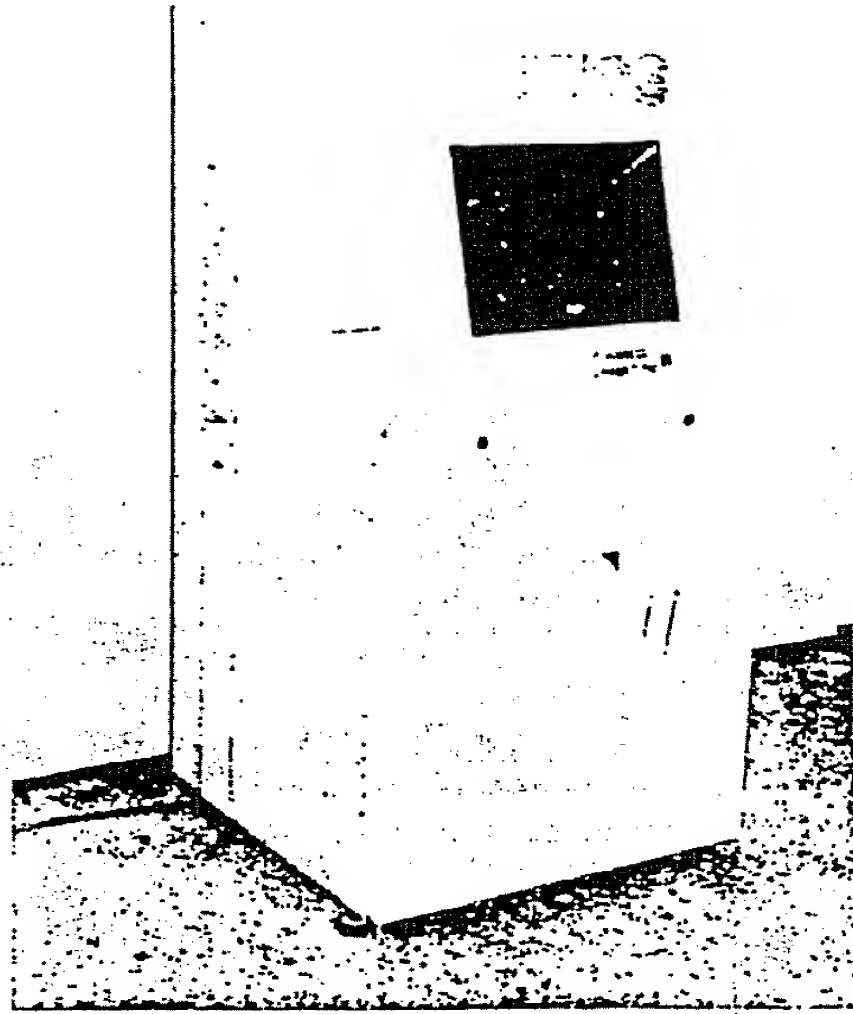


Figure 8. Traffic Information Guide Terminal

4. CURRENT SCHEDULE AND ITS PROSPECT

The basic design of the system was formed in this way and production of the pilot unit started from October, 1987, and pilot experiments started from April, 1988, as schedule. The company undertaking production of the pilot unit was made up of 12 groups, each of which was creatively carrying out production with their originality and independency within the range of the basic features and ratings. 12 pilot vehicles (11 passenger cars and one bus) participated in experiments for three months. During the pilot experiment, various basic data was collected so as to draw up a designing specification for practical use. On 22nd, June 1988 the results of this pilot experiment was shown to the public. The pilot experiment was completed successfully on 30th June 1988 and the report of results was furnished in March, 1989. Our practicability study is now under discussion.

It is planned that a teleterminal service covering the 23 wards of Tokyo will be provided at the end of 1989 and this occasion is expected to be in time to utilize AMTICS in Tokyo soon.

On 16th June, 1989, in Osaka, a Conference on Experiment of AMTICS in Kansai district was established.

The conference plans to carry out the pilot experiment during the Flower and Greenery Expo. of Osaka from April to September 1990.

Commercial vehicles such as bus, truck, taxi etc in addition to the passenger-car participate this experiment applying technologies in pilot test experienced in the field of Tokyo 1988.



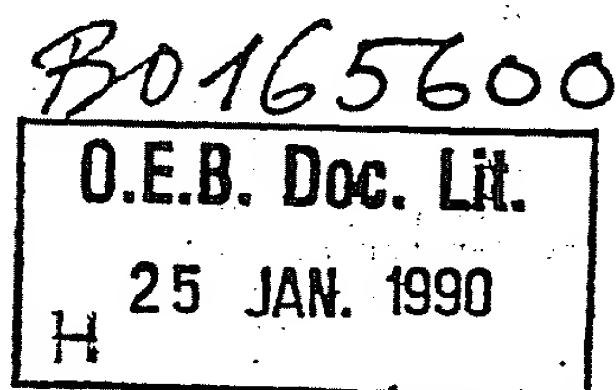
Vehicle Navigation & Information Systems

Conference Record of Papers presented at
the First Vehicle Navigation and Information
Systems Conference (VNIS '89)

King Edward Hotel
37 King Street East, Toronto, Ontario, Canada

September 11 - 13, 1989

Compiled and edited by
D.H.M. Reekie,
E.R. Case and
J. Tsai



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